

## Site Need Statement

General Reference Information	
1 *	<b>Need Title:</b> Hanford/SRS Waste Mixing Mobilization
2 *	<b>Need Code:</b> RL-WT060
3 *	<b>Need Summary:</b> <ol style="list-style-type: none"> <li>1) Hanford is considering, from a risk mitigation standpoint, enhanced sludge mobilization methods to retrieve sludge that is beyond the Effective Cleaning Radius (ECR) of the baseline pair of long-shaft mixer pumps. The objective is a small system that can be installed in the tanks along with the mixers when needed to mobilize the remaining sludge.</li> <li>2) Both Hanford and SRS are also interested in identifying replacements for baseline mixer pumps with more cost-effective alternates with respect to life-cycle/operations costs for bulk sludge, sludge heel, and salt cake retrieval both in large HLW storage tanks and in smaller process tanks such as SRS transfer system Pump Tanks.</li> <li>3) Hanford would like mixer pumps that can be started under several feet of sludge or settled salts in a straightforward manner.</li> <li>4) Hanford would like mixer pumps that can minimize or remove the pumping energy added to the tank to reduce waste heating (i.e., provide cooling).</li> </ol>
4 *	<b>Origination Date:</b> FY 2000
5 *	<b>Need Type:</b> Technology Need
6	<b>Operation Office:</b> Office of River Protection (ORP)
7	<b>Geographic Site Name:</b> Hanford Site
8 *	<b>Project:</b> Retrieval                      PBS No.: RL-TW04
9 *	<b>National Priority:</b> <ol style="list-style-type: none"> <li>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</li> <li><u>X</u> 2. <u>Medium</u> - Provides substantial benefit to EM program projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).</li> <li>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</li> </ol>
10	<b>Operations Office Priority:</b> Medium
Problem Description Information	
11	<b>Operations Office Program Description:</b> The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is: <ul style="list-style-type: none"> <li>• Retrieval of all wastes from the DSTs</li> <li>• The safe, environmentally compliant transfer of this waste to the WTP</li> <li>• DSTs in a ready state for implementing closure and final disposal of the DST farms.</li> </ul>
12	<b>Need/Problem Description:</b> Mixer pumps are the current baseline technology for retrieval of waste from DSTs. The pumps are used to mobilize and suspend sludge in HLW tanks to allow pumping the resulting slurry to another DST or the waste treatment plant. The mixer pumps are also used to dissolve settled salts in LAW tanks by mixing them with water to allow pumping the supernate to another DST or the waste treatment plant. The pumps may also be used for the blending of slurries and/or supernates to reduce variability in the feed delivered to the waste treatment plant. <p>Mixer pump technology is expensive, and has only been partially demonstrated in Hanford Tanks (for the mitigation of the flammable gas issue in tank 241-SY-101 and during the mixer pump process test conducted</p>

	<p>in tank 241-AZ-101). Because of the expense of and the limited experience base with mixer pumps at Hanford, it is desirable to continue looking for alternatives or enhancements, which are more effective, provide additional flexibility, and/or cost less.</p> <p>The existing mixer pumps, when run at full power for extended periods of time, can heat the waste faster than permitted by operating specifications. If cooling capability were provided, process control would be more straightforward and flexible because the pump power and operating time could be selected based on waste mobilization requirements rather than waste temperature changes.</p> <p>The current generation of mixer pumps has long shafts with either gas or water filled bearing columns, with seals at the top and bottom of the column. These pumps are prone to shaft alignment problems, seal failures, vibration, etc. Plus the bearing column represents a pathway from the contaminated zone to the non-contaminated environment. A new generation mixer pump or alternative mixing system is needed to offset these problems areas.</p> <p><b>Consequences of Not Filling Need:</b> One of the principal goals of this effort is to manage the performance risks of the mixer pumps. Pumps have been extensively tested with simulants both in scale and full size. Full-scale in-situ experience at Hanford is so far limited to the AZ-101 mixer pump test recently completed. While the results of the test are encouraging they do not constitute a comprehensive performance demonstration, as this specific tank is not a representative and challenging case (low sludge shear strength, small amount of sludge, etc...). There is also some risk that the Hanford waste will behave significantly differently than the simulants, and so the mixer pump performance may be different than predicted.</p> <p>Hanford and Savannah River have been cooperating with TFA to both improve the current mixer pump design and identify suitable alternative technologies. This effort needs to continue (especially regarding emerging SRS mixer pump technology data).</p> <p><b>Program Baseline Summary (PBS) No.:</b> TW04 **<b>Work Breakdown Structure (WBS) No.:</b> 5.02.02.01.04 **<b>TIP No.:</b> N/A **</p>																											
13	<p><b>Functional Performance Requirements:</b> As a baseline replacement, (Need #2 above), the mixer pump must mobilize and mix the waste to retrieve as much waste as is reasonably possible from each source tank. The following table summarizes the current baseline mixer pump and the Advanced Design Mixer Pump performance parameters and costs. The alternatives or enhancements must compete against these if they are to produce improvements.</p> <table><tr><th>Parameter</th><th>Baseline Mixer Pump (Project W-211)</th><th>Advanced Design Mixer Pump</th></tr><tr><td>Cost for each pump</td><td>\$500K</td><td>\$625K</td></tr><tr><td>U<sub>o</sub>D (nozzle velocity X nozzle diameter) ft<sup>2</sup>/sec</td><td>29.4</td><td>29.4</td></tr><tr><td>Riser diameter (inches)</td><td>42</td><td>42</td></tr><tr><td>Installed Weight (lbs)</td><td>25,000</td><td>20,000</td></tr><tr><td>Pump operating life, intermittent (hrs)</td><td>5,000</td><td>5,000</td></tr><tr><td>Pump starts/stops</td><td>100</td><td>100</td></tr><tr><td>Pump installed life in tank (years)</td><td>5</td><td>10</td></tr><tr><td>Approximate total quantity of pumps required for the RPP program life</td><td>216</td><td>86</td></tr></table> <p>For <i>Need #3</i>, Hanford would like mixer pumps that can be started under several feet of sludge or settled salts. Hanford has not yet demonstrated that a mixer pump can be started and operated under several feet of sludge or settled salts. Baseline plans assume that the pump will startup after addition of flush water (this is</p>	Parameter	Baseline Mixer Pump (Project W-211)	Advanced Design Mixer Pump	Cost for each pump	\$500K	\$625K	U <sub>o</sub> D (nozzle velocity X nozzle diameter) ft <sup>2</sup> /sec	29.4	29.4	Riser diameter (inches)	42	42	Installed Weight (lbs)	25,000	20,000	Pump operating life, intermittent (hrs)	5,000	5,000	Pump starts/stops	100	100	Pump installed life in tank (years)	5	10	Approximate total quantity of pumps required for the RPP program life	216	86
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	<p>complicated because the current mixer pump can not be operated at speeds of less than 700 rpm with damaging the pump); in the event that this approach does not work, the current risk handling action is to use a jack-screw assembly to incrementally lower the mixer pump into the waste. A mixer pump design that lends itself to a more straightforward method of start-up would significantly reduce the programmatic risk.</p> <p>For <i>Need #4</i>, Hanford would like mixer pumps fitted with a cooling system to extract the pumping energy to avoid heating the waste, this cooling system must be at least able to remove the maximum horsepower the pump driver can deliver. The existing mixer pumps, when run at full power for extended periods of time, can heat the waste faster than permitted by operating specifications. If cooling capability were provided, process control would be more straightforward and flexible because the pump power and operating time could be selected based on waste mobilization requirements rather than waste temperature changes.</p>
**	<p><b>Schedule Requirements:</b> The first waste feed delivery to the waste treatment facility will rely on mixer pumps to mobilize the waste, and is scheduled for completion of turnover to operations in 2005. Two pumps were installed in 101-AZ by project W-151 to run process tests. Project W-151 has procured a spare pump. Project W-211 has procured two pumps for installation in other DSTs. Alternatives to mixer pump technology which are more cost effective can only be considered if they are developed before the W-211 project has more mixer pumps fabricated, which will and continue each year for several years.</p> <p>Therefore, this effort should be completed soon to achieve maximum performance improvement, risk reduction, and/or cost reduction, while generating the minimum disruption to W-211 plans and design efforts.</p>
14	<b>Definition of Solution:</b>
15 *	<b>Targeted Focus Area:</b> Tanks Focus Area (TFA)
16	<b>Potential Benefits:</b>
17 *	<b>Potential Cost Savings:</b> \$20,000,000
18 *	<p><b>Potential Cost Savings Narrative:</b> The baseline cost for the current mixer pumps is \$500K per pump. The advanced design mixer pump is expected to cost \$625K per pump in production quantities. (There are actually even larger costs connected to infrastructure upgrades and support systems required by the mixer pumps; a fair comparison with an alternative technology needs to account for these costs). Therefore, any alternative technology must be cost competitive with this mixer pump to be used. Two mixer pumps are generally planned for deployment in Hanford DSTs, with a total of 50 pumps currently planned (not all DSTs will receive mixer pumps). Over the life of the RPP program about 216 of the baseline pumps will be needed. If the advanced design mixer pump replaces the baseline pump, that quantity drops to about 86 pumps. Therefore, the current baseline will spend \$108M for the baseline pump or \$53.8M for the Advanced Design Mixer Pump. These costs are embedded in already authorized capital projects totaling over \$500 million. To be cost effective alternatives must reduce this overall cost.</p>
**	<p><b>Technical Basis:</b> There are programmatic risks concerning the effectiveness of the existing mixer pump design to a) mobilize and suspend solids to the degree assumed in planning documentation, b) to be able to startup the pumps in a straightforward manner, c) overall reliability, and d) possible restrictions in pump power or operating time in order to satisfy tank waste temperature rate-of-change limits. Some of these concerns are discussed in "Test Report, 241-AZ-101 Mixer Pump Test", RPP-6548, Revision 1.</p>
19	<b>Cultural/Stakeholder Basis:</b> None expressed by STCG Tanks Subgroup.
20	<b>Environment, Safety, and Health Basis:</b> Improvements to mixer pump performance will reduce the amount of residual waste remaining in the DST when ready for closure in the future. This will reduce operator exposure when doing final clean out.
21	<b>Regulatory Drivers:</b> A failure to deliver required quantities of feed to the WTP will delay treatment, and may impact the ability to meet the RPP program commitments.
22 *	<b>Milestones:</b> Waste feed delivery milestones (2005 and onwards)
23 *	<p><b>Material Streams:</b> Sludge, salt, liquid (RL-HLW-20)  ID-2113 Sludge, Salt, Liquid Risk Score: 3</p>

	ID-2857 HLW to Treatment Risk Score: 3
24	<b>TSD System:</b> Double Shell Tank systems ID-1722 Underground Storage Tanks Risk Score: 1
25	<b>Major Contaminants:</b> Pu-238, 239, 240, 241; AM-241; U-238; C-14; Ni-59/63; Nb-94; Tc-99; I-129; Cm-242; Sr-90; Cs-137; Sn-126; Se-79; chromium; nitrate; nitrite; complexants (EDTA/HEDTA)
26	<b>Contaminated Media:</b> Dominantly steel
27	<b>Volume/Size of Contaminated Media:</b> Long length equipment
28 *	<b>Earliest Date Required:</b> September 2002
29 *	<b>Latest Date Required:</b> September 2005
<b>Baseline Technology Information</b>	
30	<b>Baseline Technology/Process:</b> The current baseline technology is the use of “Project W-211 style” mixer pumps.  <b>Technology Insertion Point(s):</b> N/A
31	<b>Life-Cycle Cost Using Baseline:</b>
32	<b>Uncertainty on Baseline Life-Cycle Cost:</b>
33	<b>Completion Date Using Baseline:</b> 2018
<b>Points of Contact (POC)</b>	
34	<b>Contractor End User POCs:</b> P.J. (Paul) Certa, NHC, 509-376-5429, F/509-376-8652 <a href="mailto:Paul_J_Certa@rl.gov">Paul_J_Certa@rl.gov</a> C. E. (Carolyn) Graves, NHC, 509-376-5235, F/509-376-5145, <a href="mailto:Carolyn_E_Cary_Graves@rl.gov">Carolyn_E_Cary_Graves@rl.gov</a>
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36 **	<b>Other Contacts:</b> R. W. (Ron) Reed, CHG, 509-373-5546, <a href="mailto:Ronald_W_Ron_Reed@rl.gov">Ronald_W_Ron_Reed@rl.gov</a> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, <a href="mailto:Kenneth_A_Ken_Gasper@rl.gov">Kenneth_A_Ken_Gasper@rl.gov</a>

\*Element of a Site Need Statement appearing in IPABS-IS